

REVIEW: TABANIDAE OF THE EAST COAST
AS AN ECONOMIC PROBLEM

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Abstract.—Tabanidae are pests of man and animals in many areas of the coastal states but especially near salt marshes. The major species, *Tabanus nigrovittatus* and *Chrysops atlanticus*, move from the marshes to nearby beaches, camp grounds, golf courses, and other recreational areas and onto boats in the bays and estuaries. *Chrysops* congregate in dense vegetation and attack when humans or animals move into such places. Both *Tabanus* and *Chrysops* are severe problems to agricultural workers when the flies are numerous. Livestock are readily attacked by Tabanidae with consequent effects on thriftiness, weight gains and milk production and possible transmission of causal agents of disease. Biology and habits of both salt marsh and upland species are poorly known. Probably *T. nigrovittatus* is a species complex. Controls are inadequate though traps and vegetative barriers have been shown useful against *Tabanus* and some insecticides have given reduction but not adequate control of both *Tabanus* and *Chrysops*.

When one thinks of the blood-sucking Diptera of the east coast one thinks first of mosquitoes as the major problem. However, in many areas 50 to 75 years of organized control programs have resulted in only sporadic mosquito annoyance. Other biting flies are then regarded as greater pests such as Tabanidae, both greenheads (*Tabanus*) and deer flies (*Chrysops*).

Tabanidae as Pests

The Tabanidae are selective feeders and only a few are important pests of humans. Especially the larger *Tabanus* seem to limit their attacks to large mammals. Only female Tabanidae take blood meals needed for maturation of eggs. Some species of both *Tabanus* and *Chrysops* are autogenous, the females depositing the first egg mass before seeking a blood meal. Nutrients for normal fly activities are obtained from flowers and other plant sources or from food reserves stored in the larval stage.

The relatively few species of Tabanidae that bite man often occur in large

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numbers and make life miserable. People feel the bite when the female pierces the skin or probes deeply for an adequate flow of blood. Usually no swelling, reddening or irritation occurs after the bite but some people have moderate reactions which last from a few minutes to several hours. A small segment of the population respond with allergic reactions involving extensive swelling, erythema, itching, and related effects. In extreme cases hospitalization is necessary and emergency measures to counteract allergic effects or anaphylactic shock are essential.

This tabanid problem is primarily associated with salt marshes, especially portions of *Spartina alterniflora* marshes. The most important fly in this area is the greenhead, *Tabanus nigrovittatus*, which often makes up 90 to 95% of the adult pest population.

The salt marsh tabanid problem extends from Nova Scotia to Florida and along the Gulf Coast to eastern Texas in areas of the salt marsh suitable to the various species or strains. Apparently suitable larval habitat for one strain of *T. nigrovittatus* exists only along banks of natural and mosquito control ditches (Freeman and Hansens, 1972).

Tabanus nigrovittatus females readily bite man and range quite widely from the salt marsh into nearby areas. Prevailing winds often favor infestation of beaches. Greenheads tend to fly within a foot or two of the ground, and thus on bathing beaches exposure of sun bathers results in maximum annoyance. A single bite often causes human response all out of proportion to the seriousness of the injury. Once the female fly settles down to feed, if one can wait that long, swatting the fly is easy. The wounds caused by tabanids are larger than those of other Diptera and blood often oozes from the wound after the fly leaves. If a larger blood vessel is pierced, bleeding may be profuse.

Occupants of fishing and pleasure boats are often attacked by greenheads. The flies readily move into the boat cabins as the vessels traverse the creeks and thoroughfares. These flies may then seek a host when the craft has moved a considerable distance from land. Flies may be attracted by petroleum products or the exhaust from gas engines. This accounts in part for the large numbers of greenheads which accumulate in power boats. Both sexes have recently been taken on oil drilling rigs in the Gulf of Mexico many miles from land and probably by direct flight from land (personal communication, John Burger, U. New Hampshire).

Golf courses in a number of localities have been constructed close to salt marshes. Vegetation may be cleared between the course and the marsh to give players a view of the wide expanse of the marsh. Observations show that such openings to the marsh greatly facilitate movement of flies to the course and subsequent annoyance of the players.

Campgrounds are a rapidly growing industry in coastal areas, especially in New Jersey. In Cape May County alone there are some 75 campgrounds.

Most of these are close to salt marshes and greenhead and deerfly annoyance is very severe. At one location in 1976 at least two children required hospital treatment for greenhead bites. At a number of locations, campers pulled stakes and left after a day or less of enduring greenheads and deer flies. This also happened on Grand Manan Island, New Brunswick, Canada (personal communication, L. L. Pechuman, Cornell Univ.).

An important problem with Tabanidae was apparent in South Carolina in the planning for the Charles Towne Landing Park in 1970 and a suitable control program was implemented (Adkins, 1974).

Greenheads have an impact on crop production in vegetable growing areas of New Jersey along Delaware Bay. In some locations intensive agriculture is surrounded on three sides by salt marsh and greenheads cause great annoyance to harvesting crews and other farm labor during much of July and August.

In other areas salt marsh has been reclaimed for housing by digging channels for boat moorings and raising adjacent land above high tide level with the spoil. Such marsh destruction removes greenhead breeding areas, but plenty of nearby marsh produces flies which easily infiltrate the developments.

Similarly the salt marsh deer flies, *Chrysops fuliginosus* and *C. atlanticus* are important pests of man. *C. atlanticus* is an avid feeder on man, exists in large numbers for several weeks, and reaches peak numbers when more people are in resorts and when crop harvesting is in progress. Along the South Atlantic coast other species are important especially in the Georgetown area of South Carolina where *C. pudicus* and *C. niger taylori* are pests (Adkins, 1974).

Human annoyance from *Chrysops* is restricted to smaller geographical areas than *Tabanus*. Deer flies from the salt marsh move into adjacent woods and other vegetation but not far into open fields. Typically they are not a problem on beaches or in boats but may be more serious than greenheads on golf courses, in camp grounds, parks, and along the wooded margins of cultivated fields. *Chrysops* tend to feed on the head and arms and are much more attracted to a moving host than one standing still. In the summer of 1976 at the margin of cultivated fields near Cedarville, N.J. as many as 180 *C. atlanticus* were taken in 10 figure-8 sweeps of an insect net over the head. With such a population, 30 actual bites were counted in 90 seconds, and observation for longer periods was unbearable.

So far reference has been made primarily to a small number of salt marsh species. There is a much larger fauna of Tabanidae in upland areas. *Chrysops* become pests in many local areas. *Chrysops vittatus* is probably the most generally distributed and hence the most annoying of the freshwater deer flies. Flies of the genus *Diachlorus* are avid biters and occasionally are important pests. Only a few species of upland *Tabanus* cause appreciable annoyance to humans.

In the Atlantic salt marsh areas, livestock production is not an important part of agriculture. The biting fly complex of mosquitoes, horse flies, deer flies, stable flies, and others greatly affects livestock thriftiness, weight gains and milk production. Granett and Hansens (1956) showed the cost of sprays on dairy animals was exceeded by increased return from milk production when blood-sucking Diptera were sharply reduced.

The amount of blood taken from livestock when *Tabanus* are present is considerable but depends on the species involved as well as the size of the population. Philip (1931) estimated a blood loss of 300 ml from a constant population of 50 flies feeding over a 10 hour period. Tashiro and Schwardt (1949 and 1953) similarly weighed engorged flies and calculated daily blood loss of 59 to 352 ml per day. Often even more blood is lost from the wounds the flies cause. In coastal areas, especially in the south, animals suffer large blood loss over several months because the fly population is very large and the fly season is prolonged. Soboleva (1956) reported loss of 40 to 200 mg of blood from feeding by a single fly and qualitative changes in blood with feeding of numerous flies, i.e. a decrease in haemoglobin and erythrocytes and an increase in leucocytes.

Disease Transmission

Active transmission of human disease agents by Tabanidae is not known to occur in the Atlantic coastal states. Possible exceptions are tularemia and the viruses of the California encephalitis group. Laboratory tests have recently demonstrated that *C. atlanticus* is an effective vector of the filarial worm *Loa loa* of Africa (Orihel and Lowrie, 1975) but introduction of the disease agent to the east coast seems unlikely.

An additional factor in livestock production is the known potential of *Tabanus* as mechanical vectors of bovine anaplasmosis, equine infectious anemia, and vesicular stomatitis (not proved) (Krinsky, 1976). Hog cholera transmission was shown by Tidwell et al. (1972). Research in New Jersey showed the populations of Tabanidae on hogs are small but the number of species which visit hogs is quite large (Weiner and Hansens, 1975). Hog cholera transmission by tabanids is believed to be insignificant but such rare occurrences may be very important in reaching our national goal of complete hog cholera eradication. Wildlife of several species are subject to trypanosomes and filarial worms transmitted by tabanids.

Control Efforts

Control of Tabanidae has yet to be achieved. A variety of measures now in use give partial control. For preventing biting of man and animals no satisfactory repellents exist though DEET and ethyl hexanediol give some reduction in *Chrysops* biting. Catts (1968) advocates use of repellent im-

pregnated shirts to reduce biting annoyance. Light colored clothing also helps reduce attacks from greenheads and deer flies (Hansens, 1947).

Insecticide applications have met with only limited success. The areas to be treated are large because large expanses of salt marsh are breeding areas for these flies and the adult flies move considerable distances. The vegetation where *Chrysops* concentrate is often difficult to penetrate with air application and is inaccessible from the ground. Concentrations of insecticide needed often exceed the amounts which are environmentally safe. Large scale control of *T. nigrovittatus* by chemicals is unlikely to be acceptable except in emergency situations. In the case of *Chrysops*, control in localized areas where flies concentrate is feasible. Synthetic pyrethroids with short residual activity may be useful. In 1976 in New Jersey treatment along the edges of fields with resmethrin sprays resulted in relief from deer flies for only a day or two (unpublished, Hansens). In recreational areas such applications might also reduce annoyance to tolerable levels.

Use of box and canopy traps for control of *T. nigrovittatus* has met with considerable success in Maine, Massachusetts, New Jersey and Delaware. Large numbers of box traps have been used in Massachusetts since 1967 to protect beach areas (Spencer, 1971), in New Jersey to reduce fly annoyance on a golf course adjacent to salt marsh, and in Delaware to protect a small community from fly annoyance. In New Jersey the traps were successful enough that one golf course now includes traps as part of their pest management program. In Massachusetts traps are operated by mosquito control agencies and are important in reducing annoyance on beaches, in marinas, on golf courses, and at horse shows. In Delaware box and canopy traps placed in flyways (openings through the barrier of vegetation along the marsh) prevented large numbers of flies from moving into inhabited areas. In all of these efforts traps do not eliminate flies but reduce them to tolerable levels. Canopy traps (personal communication, L. L. Pechuman) are being used in the Hudson Valley, N.Y. around paddocks where valuable stud horses are kept and where EIA is a problem. Horse breeders say they are a great help in reducing populations.

Flooding of breeding areas was shown to control *Chrysops* larvae in Connecticut (Anderson and Kneen, 1969) but extensive area control would destroy too much desirable salt marsh.

Research Needs

Effective control of the various tabanids on the Atlantic seaboard will be difficult to achieve without much more knowledge of the life history and habits of the flies and development of laboratory rearing technique. In the case of the salt marsh species, oviposition habits of *C. fuliginosus* are unknown. Oviposition and larval and pupal habits need more study with *T.*

nigrovittatus and *C. atlanticus*. A recent paper by Magnarelli & Anderson (1977) adds considerable knowledge relative to feeding and gonotrophic activity.

Taxonomic and biological research is needed to clarify the *T. nigrovittatus* complex. The recognition by Freeman and Hansens (1972) of two distinct larvae in two distinct habitats on the salt marsh led to the reasoning that *T. nigrovittatus* populations may be of two species which are difficult to separate as adults. The second species is probably *T. simulans* and the two species overlap in Delaware and New Jersey. We also know that many fewer of the so-called *T. nigrovittatus* are taken in box traps in North and South Carolina than in Delaware and New Jersey. *T. nigrovittatus* also is not as serious a pest of man in the Carolinas as it is farther north. All of this gives credence to the idea that a species complex exists.

In general, adequate regional keys to adults are available for both salt marsh and upland species. Keys to larvae are less complete. Our big gaps in knowledge are in biology and habits and in establishment of a laboratory colony of any species. When these are known, new approaches to control will follow. Development of adequate controls will then make life much more enjoyable in many resort and agricultural areas of the east coast.

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